

WHAT IS CLAIMED IS:

1. A method of adaptive resource allocation in transmitting data, comprising:
allocating a resource to each of a plurality of data transmitting active
connections, the plurality of active connections belonging to more than one class of
service;

determining a lender class of service for each active connection from which
resources may be reallocated to the active connection;

periodically comparing the resource usage of an active connection to an upper
threshold and a lower threshold;

borrowing resources from the lender class of service for the active connection
in response to the current usage exceeding the upper threshold; and

returning resources to the lender class of service from the active connection in
response to the current usage being less than the lower threshold.

2. The method, as set forth in claim 1, wherein periodically comparing
the resource usage comprises comparing the resource usage of the active connection
in response to receiving incoming data on the active connection.

3. The method, as set forth in claim 1, wherein periodically comparing
the resource usage comprises comparing the resource usage of the active connection
in response to receiving an incoming cell of data on the active connection.

4. The method, as set forth in claim 1, further comprising:
recording a time of the last resource reallocation action when resource was
borrowed or returned for the active connection;

comparing a current time with the last resource reallocation action time and
proceeding or not proceeding to borrowing in response to the difference therebetween.

5. The method, as set forth in claim 1, further comprising:

recording a time of the last resource reallocation action when resource was borrowed or returned for the active connection;

comparing a current time with the last resource reallocation action time; and

5 proceeding to borrowing in response to the difference between the current time and the last resource reallocation action time being greater than a predetermined minimum time spacing requirement, and not proceeding to borrowing in response to the difference between the current time and the last resource reallocation action time being less than or equal to the predetermined minimum time spacing requirement.

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6. The method, as set forth in claim 1, further comprising:

recording a time of an oldest borrow action when resource was borrowed for the active connection;

comparing a current time with the oldest borrow action time; and

15 proceeding to returning in response to the difference between the current time and the oldest borrow action time being greater than a predetermined maximum borrow time requirement.

7. The method, as set forth in claim 1, wherein borrowing comprises:

20 determining available resources of the lender class of service; and
proceed to borrowing if the available resources is sufficient.

8. The method, as set forth in claim 1, further comprising:

25 storing data associated with each borrow action for each active connection,
including:

a borrow action time;

an amount of resource borrowed for the active connection; and

an weight increment for the active connection.

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9. The method, as set forth in claim 1, further comprising:
storing data associated with each active connection, including:
a time of last resource reallocation for the active connection;
an enable indicative of whether resource reallocation is permitted for
the active connection;
a lender class identifier indicative of the class of service that resources
can be borrowed from;
an upper threshold indicative of need to borrow resources; and
a lower threshold indicative of need to return borrowed resources.

10. The method, as set forth in claim 9, wherein storing data associated
with each active connection further comprises:
storing a minimum time spacing between resource reallocation actions;
and
storing a maximum time to return borrowed resources.

11. The method, as set forth in claim 8, further comprising storing data
associated with each borrow action for each active connection in a linked list, with the
oldest borrow action at the head of the linked list.

12. The method, as set forth in claim 11, wherein returning borrowed
resources comprises removing an oldest link in the linked list.

13. The method, as set forth in claim 1, further comprising first scheduling
resources using a weighted round robin method.

14. The method, as set forth in claim 1, wherein borrowing and returning
resources comprise borrowing and returning bandwidths.

15. The method, as set forth in claim 1, wherein borrowing and returning
resources comprise increasing and decreasing data sending rate.

16. A telecommunications equipment having limited resources to allocate to active connections for a plurality of classes of services, using a method of dynamic resource allocation, comprising:

a first data structure storing resource allocation weighting data associated with each class of services;

a second data structure storing resource allocation weighting data associated with each active connection in each class of services;

wherein the second data structure includes:

a class identifier specifying a lender class of services from which resource may be borrowed;

an upper threshold indicative of when resource borrowing action for this active connection should be initiated;

a lower threshold indicative of when resource returning action for this active connection should be initiated; and

a sequence of data associated with each resource borrowing action of resources that have not been returned.

17. The telecommunications equipment, as set forth in claim 16, wherein the second data structure further comprises a timestamp of the most recent borrow or return action for the active connection.

18. The telecommunications equipment, as set forth in claim 16, wherein the second data structure further comprises a minimum time requirement between borrow and return actions for the active connection.

19. The telecommunications equipment, as set forth in claim 16, wherein the second data structure further comprises an amount of resource that may be borrowed by the active connection from the lender class of services in each borrow action.

20. The telecommunications equipment, as set forth in claim 16, wherein the second data structure further comprises a maximum time requirement that borrowed resources by the active connection need to be returned to the lender class of services.

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21. The telecommunications equipment, as set forth in claim 16, wherein the sequence of data comprises a linked list of data associated with each borrow action.

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22. The telecommunications equipment, as set forth in claim 21, wherein the data associated with each borrow action comprises a timestamp of the borrow action.

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23. The telecommunications equipment, as set forth in claim 21, wherein the data associated with each borrow action comprises a weighting increment for the active connection, and a weight decrement of the lender class of services.

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24. A method of adaptive dynamic weight assignment for transmitting data, comprising:

assigning a total weight to each class of services;

assigning a weight to each of a plurality of data transmitting active connections in each class of services;

determining a lender class of service for each active connection from which weighting may be reallocated to the active connection;

periodically comparing the resource usage of an active connection to an upper threshold and a lower threshold;

borrowing additional weighting from the lender class of service for the active connection in response to the current usage exceeding the upper threshold; and

returning borrowed weighting to the lender class of service from the active connection in response to the current usage being less than the lower threshold.

25. The method, as set forth in claim 24, wherein periodically comparing the resource usage comprises comparing the resource usage of the active connection in response to receiving incoming data on the active connection.

26. The method, as set forth in claim 24, wherein periodically comparing the resource usage comprises comparing the resource usage of the active connection in response to receiving an incoming cell of data on the active connection.

27. The method, as set forth in claim 24, further comprising:
recording a time of the last weighting reallocation action when weighting was borrowed or returned for the active connection;

comparing a current time with the last weighting reallocation action time and proceeding or not proceeding to borrowing in response to the difference therebetween.

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28. The method, as set forth in claim 24, further comprising:

recording a time of the last weighting reallocation action when weighting was borrowed or returned for the active connection;

comparing a current time with the last weighting reallocation action time; and

proceeding to borrowing in response to the difference between the current time and the last weighting reallocation action time being greater than a predetermined minimum time spacing requirement, and not proceeding to borrowing in response to the difference between the current time and the last weighting reallocation action time being less than or equal to the predetermined minimum time spacing requirement.

29. The method, as set forth in claim 24, further comprising:

recording a time of an oldest borrow action when weighting was borrowed for the active connection;

comparing a current time with the oldest borrow action time; and

proceeding to returning in response to the difference between the current time and the oldest borrow action time being greater than a predetermined maximum borrow time requirement.

30. The method, as set forth in claim 24, wherein borrowing comprises:

determining available weighting of the lender class of service; and

proceed to borrowing if the available weighting is sufficient.

31. The method, as set forth in claim 24, further comprising:

storing data associated with each borrow action for each active connection, including:

a borrow action time;

an amount of resource borrowed for the active connection; and

an weight increment for the active connection.

32. The method, as set forth in claim 24, further comprising:
storing data associated with each active connection, including:
a time of last weighting reallocation for the active connection;
an enable indicative of whether weighting reallocation is permitted for
the active connection;
a lender class identifier indicative of the class of service that weighting
can be borrowed from;
an upper threshold indicative of need to borrow weighting; and
a lower threshold indicative of need to return borrowed weighting.

33. The method, as set forth in claim 32, wherein storing data associated
with each active connection further comprises:
storing a minimum time spacing between resource reallocation actions; and
storing a maximum time to return borrowed resources.

34. The method, as set forth in claim 31, further comprising storing data
associated with each borrow action for each active connection in a linked list, with the
oldest borrow action at the head of the linked list.

35. The method, as set forth in claim 34, wherein returning borrowed
weighting comprises removing an oldest link in the linked list.

36. The method, as set forth in claim 24, further comprising using a
weighted round robin method to schedule bandwidth assignment.